Conservation Assessment

for

Torrey's Mountainmint

(Pycnanthemum torreyi Benth.)

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ILLINOIS NATURAL HISTORY SURVEY

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Pycnanthemum torreyi Benth., from the NatureServe, Arlington, Virginia website, Photo by Troy Weldy, New York Natural Heritage Program.

http://www.natureserve.org/aboutUs/nhpeli.jsp

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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EXECUTIVE SUMMARY

This Conservation Assessment is a review of the taxonomy, distribution, habitat, ecology, and status of Torrey's Mountainmint, *Pycnanthemum torreyi* Benth. (often seen as '*torrei*'), throughout the United States and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about the potential threats and conservation efforts regarding Torrey's Mountainmint to date. Torrey's Mountainmint is a fragrant perennial herb normally found in drier uplands, and it has rather conspicuous whitish to purplish flowers clustered in dense heads on its sparse branches. There may be some taxonomic problems with this plant. There are only about 20 living populations extant, and the species is known only from the United States; it has a somewhat scattered distribution in the south-central and eastern states, and it is known historically from sixteen to twenty states plus the District of Columbia, depending on one's interpretation of the species, from New Hampshire west to Kansas, south to Tennessee and Georgia. It has greatly declined in recent decades. Globally, its ranking is G2 (Imperiled world-wide); its National status in the United States is N2 (Imperiled nationally). While rare everywhere, it is, or was, probably most common in Virginia, Pennsylvania, North Carolina and New Jersey. Torrey's Mountainmint is listed as Endangered in six states, Connecticut, Maryland, New Hampshire, New Jersey, New York, and Pennsylvania and it has been listed as a plant of Special Concern in Tennessee. It may have become extirpated in at least the District of Columbia, Illinois, Kansas, Missouri, and New Hampshire. In Forest Service Region 9, Torrey's Mountainmint is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest (though it has not been seen since 1987) but not the Hoosier National Forest where it has not been found. It is at risk everywhere in its range.

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the entity throughout its range within a given planning area.

The objectives of this document are to:

-Provide an overview of the current scientific knowledge on the species.

-Provide a summary of the distribution and status on the species range-wide and within the Eastern Region of the Forest Service, in particular.

-Provide the available background information needed to prepare a subsequent Conservation Approach.

NOMENCLATURE AND TAXONOMY

Scientific Name: *Pycnanthemum torreyi* Bentham [as '*torrei*'] [1834]
Common Names: Torrey's Mountainmint; Torrey's Mountain Mint; Torrey Mountain Mint.
Synonymy: *Koellia torreyi* (Benth.) Kuntze [as '*torrei*'] [1891]

Class: Magnoliopsida (Flowering Plants - Dicotyledons)
Family: Lamiaceae (= Labiatae; The Mint Family)
Plants Code: PYTO (USDA NRCS plant database, W-1)
http://plants.usda.gov/

The mint genus *Pycnanthemum* contains approximately 17 - 20 species, depending on its interpretation, all of which grow only in North America (Chambers 1961; Mabberley 1987). Most of the species grow in the eastern United States, with the center of diversity for the genus located in the mountains of North Carolina (Chambers 1961). The several species appear to be most common in open forests and prairies, both wet and dry, as well as on barrens and other open rock habitats. As the common name Mountainmint implies, this mint genus is often associated with upland or mountain habitats, but not at extremely high elevations.

Otto Kuntze resurrected the obscure generic name *Koellia* Moench [1794] in 1891 and he and others subsequently transferred most of the species of *Pycnanthemum* into it, but this was not accepted by many botanists. In fact, the later genus *Pycnanthemum* Michaux [1803] has been formally conserved according to the International Code of Botanical Nomenclature (Greuter *et al*. 2000) with *Pycnanthemum incanum* (L.) Michx. as its type. The genus is generally included within the subfamily Nepetoideae, tribe Mentheae, placing it very close to the more widely-known and frequently cultivated genus *Mentha*, the true mints. The generic name was derived from the Greek *pycnos*, dense, and *anthemon*, flower, so named because of the compact inflorescences of small flowers (Fernald 1950).

Torrey's Mountainmint was first named by the British botanist George Bentham in honor of the American botanist John Torrey in 1834. The type (original) specimen of *P. torreyi* apparently was collected by Torrey near Princeton, New Jersey, in July, 1831, and the holotype is at the Royal Botanic Gardens, Kew, U.K. (Gandhi, pers. comm.). The specific epithet *torreyi* derives from a Latinized word meaning 'of Torrey' or 'Torrey's'. The epithet was first published as '*torrei*', but recently the rules in the International Code of Botanical Nomenclature (McNeill *et al.* 2006, Article 60.7, see Ex. 15) have changed, and this epithet must now be spelled '*torreyi*'. This was long anticipated by Asa Gray in 1878, who corrected it to "*torreyi*" in his Synoptical Flora of North America, 2(1): 355.

Pycnanthemum torreyi has been long recognized as being very similar to *Pycnanthemum verticillatum* (Michx.) Pers. (Fernald 1899), and evidence suggests that it is also most closely related to that species. The name *Pycnanthemum torreyi* Benth. var. *leptodon* (Gray) Boomhour is today considered to be a synonym of *P. verticillatum* var. *verticillatum*. Radford *et al.* (1968) include *Pycnanthemum torreyi* Bentham itself as a synonym of *P. verticillatum*, within which they also include *P. torreyi* var. *leptodon* and *P. clinopodioides*. They state: "This species is very similar to *P. muticum* and may represent a hybrid of it and one of the narrow leaved species such as *P. tenuifolium*." p. 918. Smith (1978) also included this mint as a synonym of *Pycnanthemum verticillatum*, and stated: "Steyermark (1963) listed this species for Arkansas. Browne (1974) reported it for Stone County; I have not seen the voucher. This "species" may be merely a hybrid of *P. muticum* X *P. tenuifolium* (cf. Radford *et al*., 1968)."

Pycnanthemum torreyi is a fertile tetraploid species (2*n* = 80; Chambers and Chambers 1971) and according to them *Pycnanthemum tenuifolium* could be a parent of *P. torreyi* on morphological grounds (Chambers and Chambers 1971). They place *P. torreyi* in the 'Virginianum Group' (Sections are being worked out as this is being written; Chambers and Chambers, pers. comm.) together with *P. muticum*, *P. pilosum*, *P. tenuifolium*, *P. virginianum*, and *P. verticillatum*. While *Pycnanthemum torreyi* has been merged with *P. verticillatum* as a synonym by several botanists in the past, as mentioned above, Fernald (1899) provided a review that showed, in his opinion, why this should not be done.

Recent annotations on herbarium specimens by T. C. Yetter (dated 1991) as well as personal discussions on this plant with George Yatskievych and Mike Homoya have resulted in some confusion as to the status of the Midwestern plants that have been identified as this species. As far as can be determined, the name for these plants has not yet been changed and no means of distinguishing them has yet come to my attention. Therefore, these individuals are being treated as *Pycnanthemum torreyi* in this report.

DESCRIPTION OF SPECIES

Pycnanthemum torreyi, Torrey's Mountainmint, is a rhizomatous erect perennial herb, from fibrous roots, generally 1 – 1.5 meters tall, loosely branched with somewhat elongating 4-sided stems, these finely pubescent with minute hairs above, and essentially glabrous below; the entire plant has a pungent minty aroma; the **leaves** are simple, opposite, decussate, punctate, thin and membranaceous, distinctly short-petioled [not sessile] with petioles 1-4 mm long on median leaves, with 2-4 pairs of veins (the uppermost arising near the middle of the blade and extending to the tip), their shape is narrow, lanceolate to lance-linear, the larger ones are 0.4-1.5 cm wide X 4-6 (-9) cm long, less than a third as wide as long, nearly glabrous but often with a few hairs at least beneath especially on the midveins, the margins are entire (perhaps the largest lower leaves slightly serrate?); the **flowers** are white to pale purplish with dotted lips (see cover illustration),

they are conspicuously exserted but in dense clusters [glomerules] gathered into hemispheric head-like clusters 6-15 mm wide at tips of stem and upper branches, and the glomerule branches are normally concealed by bracts; the outer divergent or reflexed leaf-like **bracts** are prolonged and often are longer than the heads and are glabrous on the upper surfaces or puberulent on both sides, all but the outermost bracts are lance-acuminate and with an excurrent midvein (subulate tipped), the inner bracts are closely appressed, puberulent, and ciliate; the 5-lobed **calyx** is not conspicuously two-lipped, it is 4-5 mm long, 10-13 nerved, the calyx teeth are of essentially equal length, narrow, 1.5-2 mm long, lance-acuminate (narrowly triangular), and pilose (especially on their edges), and they are not spine-tipped; the **corolla** [see cover photo] is gradually enlarged upward, rather short, 3.5-5 mm long, two-lipped, the upper lip is straight and not lobed, the lower lip is 3-cleft, its lobes all ovate to oblong and obtuse; there are 4 **stamens**, the lower pair of stamens is longer than the upper, and their anther locules are parallel; the anthers are conspicuously exserted from the corolla and they are obviously fertile with much pollen; the ovary is 4-lobed; the **fruit** is composed of 4 tiny nutlets that are glabrous or sometimes hairy at the tips. The plants normally flower from (late) June - October, and the fruits can be mature from late July to October, or sometimes later. The chromosome number is $2n = 80$. (Adapted primarily from Fernald 1950, Steyermark 1963, Gleason and Cronquist 1991, Brown and Brown 1984, W-3).

Torrey's Mountainmint can be recognized by its minutely pubescent stems, its short-petioled narrow leaves (more than 3X as long as wide, < 15 mm wide) that are soft and have few veins, by its nearly glabrous outer floral bracts, its tightly-packed flower heads, its prolonged and often reflexed outer bracts, its soft-hairy calyx teeth that are sharp but not spine-tipped, and by the exserted stamens with obviously pollen-rich anthers (H.Chambers, pers. comm.). It can be distinguished from several other species of *Pycnanthemum* (*e.g.*, *P. albescens, P. clinopodioides, P. incanum, P. pycnanthemoides*) most easily by its regular (not bilabiate) calyx. Among the similar species, *Pycnanthemum clinopodioides* differs from *P. torreyi* by its looser flower heads and long flexuous calyx hairs, *P. tenuifolium* differs by its essentially glabrous stem (and leaves?), linear sessile leaves, and sharp-tipped glabrescent calyx, and *P. verticillatum* differs by its generally slightly wider leaves (on average), canescent foliaceous bracts, more open flower clusters, and shorter (0.7-1 mm) calyx teeth that are deltoid rather than narrow and sharp (Fernald 1950; Gleason and Cronquist 1991).

HABITAT AND ECOLOGY

Torrey's Mountainmint has not been given a national wetland indicator status and it does not occur in wetlands (Reed 1988; W-2). Overall, its habitats include dry upland forests, sandstone barrens, and thickets. It is rare throughout its range, and it appears to prefer, and is most common in, the more moderate climates of the central and Mid-Atlantic States at relatively low elevations.

A review of the literature demonstrates that this herb has a variety of plant associates and habitats throughout its range. *Pycnanthemum torreyi* grows mainly in open dry woods (dry-mesic upland forests), dry-mesic barrens, and thickets. Floras have listed the habitat of *Pycnanthemum torreyi* as "Dry, often fertile, woods and thickets" (Fernald 1950), "Dry upland woods" (Gleason and Cronquist 1991), "Dry woods" (Mohlenbrock 2002), "dry open woods" (Steyermark 1963), and "upland woods and thickets" (Rhoads and Block 2000). Henrietta Chambers (pers. comm.) has seen this mint personally or via specimens in deciduous woods, thickets, fields, rocky hillsides, and alluvial banks at elevations from 10 – 1,000 meters. She also remarks that she has never seen it sympatric with other species of the genus, though some others have listed *Pycnanthemum flexuosum* and *P. incanum* as occasional associates.

Torrey's Mountainmint is sometimes said to grow over ultramafic or calcareous rock. At other sites, it is more frequently found associated with plants preferring acidic soils. In Virginia this mint is located on a broad dome of basic rock (gabbro?), and in Maryland it has been found in semi-basic soil from igneous rock, on serpentine, and on other neutral alfisols (W-3). In Illinois it has been found in acidic soils derived from sandstone. At this time its pH preferences are not well known. Furthermore, while it appears to be more common in rocky shallow soils than in deeper ones, its presence occasionally on alluvial banks would suggest that soil depth can also be variable.

In Connecticut, New Jersey and adjacent New York, *Pycnanthemum torreyi* has been found on a series of basalt ridges in the piedmont; the terrain is dry, steep and rocky, and often south-facing. Here, Torrey's Mountainmint is found within the traprock [basalt] glades and hickory-ash-red cedar woodland complex at such localities as Preakness Mountain (W-4). Both acidic and calcareous microhabitats occur on this landscape and the basalt is often calcium rich with calcite inclusions (Hill, pers. obs.). These are open woodlands on shallow, rocky soil with 30-60 % canopy coverage. Associated **trees** include *Carya glabra, Carya ovalis, Fraxinus americana, Juniperus communis, Juniperus virginiana, Prunus serotina, Quercus alba, Quercus prinoides Quercus prinus,* and *Quercus velutina,* **shrubs** can include *Gaylussacia frondosa, Rhus glabra, Rosa carolina, Vaccinium pallidum, Vaccinium stamineum,* and *Viburnum rafinesquianum,* the **vines** *Parthenocissus quinquefolia* and *Toxicodendron radicans,* the **forbs** *Agalinis tenuifolia, Aquilegia canadensis, Arabis missouriensis, Aster linariifolius, Corydalis sempervirens, Diodia teres, Euthamia graminifolia, Hypericum gentianoides, Krigia virginica, Lechea pulchella, Lespedeza violacea, Opuntia humifusa, Polygonum tenue, Potentilla simplex, Solidago bicolor, Solidago nemoralis, Tephrosia virginiana, Trichostema dichotomum,* and *Viola sagittata,* and the **graminoids** *Andropogon* sp., *Bulbostylis capillaris, Carex platyphylla, Danthonia spicata, Panicum* (*Dichanthelium*) *linearifolium, Panicum* (*Dichanthelium*) *sphaerocarpum,* and *Schizachyrium scoparium*. As recently as 2003, a new population of approximately 200 plants was discovered along a natural roadside of a busy highway on Staten Island, New York (Lamont

and Young 2004). This population was occasionally mowed and its associates included exotic species as well as native ones. In at least one other colony in New York, *Pycnanthemum torreyi* has been found in open woodlands and cedar glades on limestone, with *Aster laevis*, *Bouteloua curtipendula*, *Onosmodium virginianum*, *Pycnanthemum incanum*, and *Sorghastrum nutans* (W-3).

In Maryland, Delaware, and Virginia *Pycnanthemum torreyi* has been found mostly in dry to mesic oak-hickory forests, especially in rocky shaded habitat, and often along powerline corridors and old roads (W-3). The habitats or plant communities in these three states have been described as dry to mesic oak forests, forested banks, rocky woods, edges of woods, xeric rocky forests, dry powerline corridors, roadside oak openings, a wet sphagnum bank, a little bluestem grassland, dry rocky deciduous woods, in thickets along streams, an exposed west-facing ledge, and a small diabase knob. Associated plants with this mint in several different plant communities include the **trees** *Carya* spp., *Cercis canadensis*, and *Quercus* spp., the **shrubs** *Rhus* spp. and *Rubus* spp., the **vines** *Lonicera japonica* (not native), *Parthenocissus* sp., and *Phaseolus polystachios*, the **forbs** *Desmodium paniculatum*, *Helianthus divaricatus*, *Heliopsis helianthoides*, *Pycnanthemum flexuosum*, *Pycnanthemum incanum*, *Sabatia angularis*, *Solidago patula*, *Solidago rugosa*, and *Triosteum angustifolium*, the **graminoids** *Andropogon gerardii*, *Danthonia spicata*, *Schizachyrium scoparium*, and *Sorghastrum nutans*, and the **pteridophytes** *Cheilanthes lanosa* and *Lycopodium complanatum*.

Also in Virginia, *Pycnanthemum torreyi* is known within the Dismal Creek watershed in a somewhat different habitat, associated both with a dry upland forest and its margin near a seep (W-5). The associated forest grows in an acidic habitat, though the seep in the vicinity was calcareous. Associated species with this mint here include the **trees** *Acer rubrum*, *Castanea dentata* [sprouts], *Magnolia acuminata*, *Nyssa sylvatica*, *Oxydendrum arboreum*, *Pinus strobus*, *Quercus alba*, *Quercus velutina*, *Sassafras albidum*, and *Tsuga canadensis*, the **shrubs** *Castanea pumila*, *Corylus americana*, *Gaultheria procumbens* (a ground-cover), *Kalmia latifolia*, *Lyonia ligustrina*, *Rosa carolina*, and *Vaccinium pallidum*, the **vines** *Dioscorea quaternata* and *Smilax glauca*, the **forbs** *Cacalia atriplicifolia*, *Galax aphylla*, *Hypoxis hirsuta*, and *Viola conspersa*, and the **graminoids** *Panicum* (*Dichanthelium*) *dichotomum*, and *Stipa avenacea*.

In North Carolina, Torrey's Mountainmint has been found in the mountains and in the piedmont in rich woods and usually on basic rocks such as gabbro or diabase; some sites seem to have been maintained in the past a opened areas, probably by fire and other activities (W-3).

At the north-central limit of its range in Illinois, *Pycnanthemum torreyi* grows in dry upland forests and thickets in the southern tip of the state (Herkert and Ebinger 2002). Reported habitats include dry-mesic barrens in the Shawnee National Forest in Pope County and the edge of a sandstone glade in Jackson County (Herkert and Ebinger 2002; White and Madany 1978).

Within this habitat dominant plants include the **trees** *Juniperus virginiana, Nyssa sylvatica, Quercus imbricaria, Quercus marilandica, Quercus stellata,* and *Ulmus alata*, the **shrubs** *Rhus aromatica, Ribes missouriense, Vaccinium arboreum,* and *Vaccinium pallidum*, the **forbs** *Antennaria plantaginifolia, Aruncus dioicus, Corydalis flavula, Heuchera americana, Liatris scabra, Mitchella repens, Mitella diphylla, Oenothera linifolia, Sabatia angularis,* and *Stylosanthes biflora*, and the **graminoids** *Brachyelytrum erectum, Koeleria cristata, Muhlenbergia racemosa, Muhlenbergia sobolifera, Muhlenbergia sylvatica, Panicum* (*Dichanthelium*) *sphaerocarpum, Schizachyrium scoparium,* and *Sporobolus vaginiflorus*.

In Missouri, *Pycnanthemum torreyi* is known from only a single historic record in Dunklin County, southeastern Missouri (Steyermark 1963; Yatskievych, pers. comm.). Little is known about its associates or habitat in Missouri other than from that specimen's label that describes it as alongside a stream at an elevation of 830 feet. Dunklin County is in the Southeastern, or Mississippi Lowlands, Natural Division, an area of low ridges that were former dune systems as well as floodplains, and the area is known for its dry forests and some sand prairies, as well as floodplain forests and swamps; most of the natural habitats have been eliminated there from timber removal and large-scale conversion into agricultural land (Yatskievych 1999). This area, and a small area of nearby southern Illinois, represents the northernmost extension of the Gulf Coastal Plain in the United States. Among other plants restricted to this Natural Division (excluding many species that are also present but not restricted to this division; Yatskievych 1999) that may associate with *Pycnanthemum torreyi*, are the **trees** *Carya pallida, Fraxinus tomentosa, Ilex opaca, Quercus nigra, Quercus texana,* and *Ulmus crassifolia,* the **shrub**s *Aronia melanocarpa, Crataegus marshallii, Euonymus americanus, Neviusia alabamensis,* and *Styrax americana,* the **vines** *Bignonia capreolata, Clematis crispa, Rhynchosia difformis,* and *Vitis rotundifolia,* the **forbs** *Crotonopsis linearis, Desmodium strictum, Desmodium viridiflorum, Eupatorium incarnatum, Gaillardia aestivalis, Lobelia puberula, Polymnia laevigata, Sanicula smallii,* and *Trichostema setaceum,* and the **graminoids** *Aristida desmantha, Aristida lanosa, Chasmanthium laxum,* and *Erianthus strictus*.

DISTRIBUTION AND ABUNDANCE

Pycnanthemum torreyi, Torrey's Mountainmint, is known to exist in only approximately 20 extant occurrences world-wide. The species is apparently declining throughout its range and it is possibly extirpated in Illinois, Kansas, Missouri, New Hampshire, and in the District of Columbia (W-3; Kartesz and Meacham 1999). The literature has contradictory reports on whether or not it still exists in North Carolina, but the Nature Conservancy indicates that it is extant in five counties in that state (W-3). More populations may yet be found in unsearched portions of its wide range. It has been historically restricted to the south-central and eastern United States only, but in the past, as today, populations are widely scattered (W-3).

This perennial mint is known to have occurred historically in sixteen to twenty states, namely, Arkansas (?), Connecticut, Delaware, Georgia (?), Illinois, Indiana (?), Kansas, Kentucky, Maryland, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio (?), Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia, as well as in the District of Columbia (W-1, W-3). It has been recognized as occurring in only sixteen states plus the District of Columbia by the Nature Conservancy and its associates (W-3; Kartesz and Meacham 1999). These states are Connecticut, Delaware, Illinois, Kansas, Kentucky, Maryland, Missouri, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia, and the District of Columbia. Steyermark (1963) indicated its presence in Arkansas, but this has not been verified (Yatskievych, pers. comm.). Smith (1978) may have intended to report this mint from Arkansas, but because he included it as a synonym of *Pycnanthemum verticillatum*, the record is uncertain and few appear to accept its occurrence in Arkansas. Torrey's Mountainmint was reported by Grant and Epling (1943) from Wyandotte County, Kansas, on the basis of one specimen of possible hybrid origin, but it was excluded from the flora of Kansas by McGregor *et al.* (1976). At least one specimen from Rabun County, Georgia, has been annotated as this species by both Epling in 1939 and Yetter in 1991 – it was collected in 1893 but no recent specimens are known from that state. Its status in Indiana remains confused – Kartesz and Meacham (1999) included it in Indiana and cited a voucher at Indiana University, Bloomington. According to Mike Homoya (pers. comm.) the Midwestern plants may not be this species, but this has yet to be worked out. Deam (1940) did not include this mint in Indiana.

Specimens identified as this species from Adams and Jackson counties, Ohio, are at the herbarium of Miami University (MU). These records need to be investigated. Michael Vincent (MU) recently brought these specimens to my attention. He also remarked that "*Pycnanthemum torreyi* was reported for Ohio by Fernald (1950 – Gray's Manual), but was excluded from Ohio by Cooperrider (1995 – Dicotyledonae of Ohio) and Cooperrider et al (2001 – 7th Catalog of the Vascular Plants of Ohio)". Fernald (1950) actually reported *P. torreyi* var. *leptodon* (A.Gray) Boomhour from Ohio, and not *P. torreyi torreyi*. The specimens at MU may or may not be *P. verticillatum*, then, because the var. *leptodon* is generally considered to be a synonym of that species.

Pycnanthemum torreyi is rare everywhere in its range (W-1, W-3), and its range includes both formerly glaciated and unglaciated areas. The distribution of this mint has severely decreased in recent decades, as stated above, and it is becoming scarce everywhere and not just at the margins of its range. Historic occurrences outnumber extant occurrences in almost all the states where it has been found (W-3). One can generally expect that a decline has occurred in recent decades mostly because of the general loss and degradation of its natural habitats nationally.

Pycnanthemum torreyi overlaps in range with several other species of *Pycnanthemum*, but

definite hybrids have not been distinguished. It appears that some hybrids between other species of the genus may sometimes be mistaken for this species (such as, perhaps, those involving *P. tenuifolium*, *P. verticillatum* and *P. pilosum*).

The frequency of Torrey's Mountainmint is very low, with only about 20 known populations known to be extant (W-3). The frequency cannot be precisely determined by its state rankings because it has not been ranked in Kansas, Kentucky, Pennsylvania or South Carolina (W-3) and there remains some question as to whether it truly occurs in Arkansas, Georgia, and Indiana. Also, there is other contradictory information in the literature; for example, it is said to be 'historic only' in Illinois and North Carolina yet also stated to currently occur in one county in Illinois and five counties in North Carolina on the same Internet site (W-3).

Based on known herbarium records and other sources (see appendices), this mint would appear to occur (either presently or historically) most frequently in Virginia (13 counties), Pennsylvania (11 counties), North Carolina (9 counties), New Jersey (8 counties), Kentucky (7 counties), Maryland (7 counties), and New York (6 counties). In all other states from which it has been reported, it has been found in five or fewer counties. Additional details on the distribution of this herb can be found in Kartesz and Meacham (1999) and at several Internet sites (*e.g.*, W-1, W-3). Representative specimens of this herb have been listed in Appendix 1. A summary of the distribution of Torrey's Mountainmint has been presented in Appendix 2. It must be noted here, that the accuracy of the literature and herbarium records depends upon the accuracy of the specimen identifications; for years, many of these specimens may have been confused with similar taxa, and some of its taxonomy still must be clarified.

At the north-central limit of its range in Illinois, *Pycnanthemum torreyi* has been found at the southern tip of the state (Herkert and Ebinger 2002). Historical populations are known from dry-mesic barrens in the Shawnee National Forest in Pope County and the edge of a sandstone glade in Jackson County, though no reports are recent (Herkert and Ebinger 2002; White and Madany 1978). There are unconfirmed reports that it is also in Alexander County. It is restricted to the Shawnee Hills Division, Greater Shawnee Hills Section and Lesser Shawnee Hills Section, the Coastal Plain Division, Cretaceous Hills Section, and possibly also the Ozark Division, Southern Section (Schwegman *et al.* 1973; Herkert and Ebinger 2002). It was last seen in Illinois in 1987 at the Cretaceous Hills Ecological Area within Sumter National Forest, and no extant sites are known, but much suitable habitat still exists (Shawnee National Forest 2005).

This species' status and distribution in Indiana is unknown, though one report is known in Brown County. In Missouri, it has been reported from a single county (Dunklin County) in the extreme southern tip of the state. *Pycnanthemum torreyi* has not been reported from Iowa or Wisconsin. The Ohio specimens still need verification – the species cannot yet be confirmed in Ohio.

Within the U.S. Forest Service Eastern Region (Region 9) *Pycnanthemum torreyi* has been found within the Shawnee National Forest in Illinois. It is considered by the Forest Service to be at risk in Illinois. It has not been found in the Hoosier National Forest in Indiana, the Mark Twain National Forest in Missouri, nor in the Daniel Boone National Forest in Kentucky. It is unlikely to be present within other Region 9 forests.

The populations of this herb in Illinois, Kentucky, and other parts of the Midwest, if they still exist, are scattered widely and the populations are isolated from one another. It is probable that the species was somewhat more common in the region at the time of European settlement, but there is no direct evidence for this because there are few early herbarium records from the Midwest from that period. The forests in the region are thought to have been kept open by means of fires set by the earlier inhabitants in the area before European settlement, and there is some evidence that *Pycnanthemum torreyi* thrives far better in open forest areas; the suppression of fires later may have led to a decline in the number of populations. However, it is just as likely that open woodlands where it may have occurred have been developed or disturbed by agriculture and housing in the past 200 years, in which case there may have been a significant population decline for that reason as well.

There is only a little data available on population sizes for this herb, and herbarium label data rarely include its local frequency or abundance. Approximately 200 plants were found in a single population on Staten Island, New York, in 2003 (Lamont and Young 2004). In general, populations occur as small dense colonies which are vulnerable to destruction (W-3). High Mountain Park Preserve in Wayne Township, northern New Jersey, 1,393 acres of natural lands in suburban New Jersey, is said to have the Earth's most viable population of Torrey's Mountainmint, though a precise count of the number of individuals is not available. The Naked Mountain Natural Area Preserve (Nature Conservancy) in Nelson County, Virginia, has a 'small population' of Torrey's Mountainmint and it is protected there.

PROTECTION STATUS

The Nature Conservancy global ranking for *Pycnanthemum torreyi* is G2 (Imperiled; W-3), indicating that the species is in danger of extinction worldwide. In the United States, overall, the species is given the National Heritage rank of N2 for the same reason. In the United States, official protection for this herb outside of Forest Service lands depends upon state and local laws because it is not listed as federally threatened or endangered. It has been protected in a few private nature preserves.

The state rankings vary somewhat. *Pycnanthemum torreyi* is not protected in Illinois (Illinois Endangered Species Protection Board 2005). Current policy is to remove species thought to be extirpated from the state from the T&E lists (Ebinger, pers. comm.). Until 2004, Torrey's

Mountainmint (as 'Mountain Mint') was listed as Endangered in Illinois (Herkert and Ebinger 2002) and it is currently ranked in the state as SH (presumed extirpated, though suitable habitat exists). The species remains listed as Endangered in Connecticut (Critically Imperiled – S1), Maryland (Critically Imperiled – S1), New Hampshire, New Jersey (Critically Imperiled – S1), New York (Critically Imperiled – S1), and in Pennsylvania, and it is categorized as a species of Special Concern in Tennessee (Critically Imperiled – S1). Its ranking also indicates that it is Critically Imperiled (S1) in Delaware and West Virginia and it is considered to be Imperiled (as 'S2?') in Virginia (W-3). This species has been listed as historic only (SH, presumed extirpated) in Missouri, New Hampshire, and North Carolina and as extirpated (SX) in the District of Columbia. It is not ranked (SNR, SU) in Arkansas, Georgia, Indiana, Kansas, Kentucky, Pennsylvania, and South Carolina though it may occur in these states.

In Forest Service Region 9, Torrey's Mountainmint is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest but not the Hoosier National Forest, where it has not been found (W-6; Shawnee National Forest 2005). It is not known to occur within any National forests within Region 9 currently.

Table 1 lists the official state rank for *Pycnanthemum torreyi* assigned by each state's Natural Heritage program according to the Nature Conservancy at their Internet site (W-3). Appendix 3 explains the meanings of the acronyms used (W-7).

A summary of the current official protection status for *Pycnanthemum torreyi* follows:

U.S. Fish and Wildlife Service:	Not listed (None).
U.S. Forest Service:	Listed as at risk in the Shawnee National Forest only, Region 9
Global Heritage Status Rank:	G2
U.S. National Heritage Status Rank:	N2

Table 1: S-ranks for *Pycnanthemum torreyi* in the United States [Heritage identifier: PDLAM1N0G0]

State/Province	Heritage S-rank		State/Province	Heritage S-rank	
Connecticut	S1	[Endangered]	New Jersey	S1	[Endangered]
Delaware	S1		New York	S1	[Endangered]

District of Columbia	SX	North Carolina	SH
Illinois	SH	Pennsylvania	SU [Endangered]
Kansas	SNR	South Carolina	SNR
Kentucky	SNR	Tennessee	S1 [Special Concern]
Maryland	S1 [Endangered]	Virginia	S2?
Missouri	SH	West Virginia	S1
New Hampshire	SH [Endangered]		

LIFE HISTORY

Pycnanthemum torreyi is a rhizomatous perennial herb that can form small dense colonies (W-3). Very little is known about its life history, but it is thought to be typical of most other members of the genus that live in uplands as well as like that of the similar genus *Monarda*.

The individual flowers contain both male and female parts; the many flowers in each cluster open over a period of time and they are believed to be insect pollinated. The degree of self compatibility is not known. The anthers are well-exserted from the corolla and pollen appears normal and viable. Specific pollinators are not known. Several species of bees have been seen visiting flowers of other *Pycnanthemum* species (Bartholomew 2004). Wasps of several species are also frequent visitors on *Pycnanthemum* flowers (Hill, pers. obs.).

Torrey's Mountainmint is a fertile tetraploid species with a chromosome number of 2n = 80. It may be a fertile hybrid (allopolyploid) between two other species, one of which could be *Pycnanthemum tenuifolium* (Chambers and Chambers 1971). It does not appear to further hybridize with other species.

Pycnanthemum species in general contain aromatic oils throughout the plant, and these are thought to repel insects and to usually prevent animals from eating them. Nevertheless, Miller *et al.* (1992) have reported that *Pycnanthemum torreyi* is browsed by deer and that that they can damage populations significantly. Insect predation does appear to be minimal.

Torrey's Mountainmint's flowering period is generally from late June to October throughout its range (W-3). Based on herbarium specimens examined, most plants are in flower in mid July (Virginia plants were still in bud on July 9), and the plants continue flowering until at least August 30. The earliest fruits seen were on plants collected on July 18 (Washington, D.C.) and the latest were on plants collected on October 29 (in Missouri). Herbarium specimens suggest that peak flowering is in mid to late July and peak fruiting is in early to mid-September.

Data on the longevity of individual plants of this species is lacking. Based on its habit and appearance, it probably follows the same general pattern as *Pycnanthemum incanum* and similar genera such as *Monarda* – perennials that are nonetheless fragile and doubtfully persist more than 3-10 years at a site (Hill, pers. obs.). In mild or hospitable conditions, and because the plants are capable of rooting from the lower stem nodes, it would seem that a colony could persist indefinitely through vegetative expansion, but no studies are known that either support or refute this hypothesis. Likewise, though the plants are capable of producing hundreds of seeds in a given year, there is no data available on the survivability of seedlings or the establishment of

new colonies.

The fruiting stems are herbaceous and not especially durable and they rarely last through the winter. They persist long enough to fling seeds around after they are ripe, so that strong winds or animals brushing against plants might contribute to dispersal; no other seed dispersal mechanism is known for these plants. This means of dispersal may be comparable for that studied in *Chamaelirium luteum*, another species with a tall, springy fruiting stem. Regarding *Chamaelirium*, Meagher and co-workers surmise that since the flowering stalk of *C. luteum* is somewhat springy, seeds may be loosened and thrown from the capsules if the stalk is pulled back and released. The height of the plants may be an adaptation to increase the distance to which seeds can be spread (Meagher 1978, Meagher and Antonovics 1982). Studies in one mapped North Carolina population of *Chamaelirium* (Meagher and Thompson 1987) revealed that seed dispersal distances averaged 10.1 – 10.4 m. Their height and dispersal distance, being somewhat similar to that of *Pycnanthemum torreyi*, may be comparable to that species as well. The plants using this type of seed dispersal, often called the 'slingshot effect', have been referred to as 'Passive Balists' [as in ballistics] by van der Pijl (1969). While *Pycnanthemum* is not specifically detailed, Bouman and Meeuse (1992) have presented much information on the dispersal of the nutlets in the mint family.

At least one website (http://ivygarth.com/images/Perennials.htm) suggests that light is needed for germination of *Pycnanthemum* seeds, and that an ideal germination temperature is between 68 – 75 ° F. Information on the need for stratification or conditions for seed dormancy is lacking.

POPULATION BIOLOGY AND VIABILITY

Torrey's Mountainmint, with numerous flowers in each inflorescence head, is thought to produce seeds successfully. It also is assumed, like related species, to be visited and pollinated by a diversity of insects, especially bees (Bartholomew 2004). No reproductive problems have been demonstrated in the species. However, little has been reported on any aspect of population biology in *Pycnanthemum torreyi*. The survival rate of seeds and seedlings in the wild is also not known. As stated in the section on Distribution and Abundance above, the local frequency or abundance of individuals within its populations has only rarely been recorded and there is little additional data on the density of the populations and the area covered by each. This is not unusual. Even the more common species in our flora have only limited population data of this kind available. As evidenced by the distribution of this species as well as by its ranking as Imperiled (G2) by the Nature Conservancy (W-3), populations of this species are everywhere scarce, and few may be fully viable. As a perennial adapted to often shallow soils and dry conditions, *Pycnanthemum torreyi* appears to be resistant to drought conditions and some local perturbations of its environment, including fire. It is more likely, then, that long-term changes or sudden environmental destruction would be responsible for the loss of a population (see Threats section below).

Pycnanthemum torreyi is thought to have a typical life history for a perennial herbaceous mint. Its population dynamics are largely unknown, however. As in the case of other mints, the aromatic oils, found throughout the plant, appear to be effective in repelling grazing insects but not all foraging mammals. The species is insect pollinated and grows in open dry forests. It

appears that one of the typical landscape patterns for the plant is to have individuals growing significant distances from one another in dense colonies, but specific data on this and on population sizes per unit area are not available. It is possible that small populations of widely scattered plants may not produce many seeds during years in which insect populations are stressed or during droughts when the plants have insufficient water to flower, and this could result in long-term population declines if the situation persists.

It is generally understood that fertility is reduced in inbred populations through the process of autogamy (self-fertilization). Autogamy is useful to the plant when there are small numbers of individuals per area, since the safeguarding of the success of propagation is more important than the production of new genotypes. In primary habitats, those that are generally poorly vegetated, initial success is very important. However, in subsequent periods of vegetation increase, pioneers are often substituted by other, more competitive species (W-8). In plants such as Torrey's Mountainmint, all individuals at a site may be very closely related (or even clonal) and they can be progeny from a single introduction event, and so they may posses little genetic variability. Fertilization by self-pollination or by close siblings is the most likely outcome in such cases because there is almost no chance of fertilization by other genotypes unless they are within dispersal range. The populations of this herb are isolated from one another by the nature of their habitat and by the very small number of known extant populations. In theory, continued fertilization within a group of closely related individuals can result in severe reproductive problems in these few isolated populations, and successful seed production, as well as the genetic variation that allows competition with other species, may be compromised (W-8). It is not known if this has already happened in *Pycnanthemum torreyi*.

An example of negative effects thought to have arisen through the isolation of populations can be seen in the case of a monocot, Ofer Hollow Reedgrass (*Calamagrostis porteri* ssp. *insperata* (Swallen) C.W.Greene), which has become isolated on rather dry sandstone bluffs throughout its range. This grass almost never produces viable seed anywhere in its range and this reproductive failure may be a reflection of a high genetic load that has occurred as a result of its long isolation (see Hill 2003). High genetic load can be seen in dominant mutations that result in factors lethal to embryos, and this situation appears to be indicated in that grass. That plant survives as a rare relict in the vegetative state only. It is a vulnerable species in the Midwest and elsewhere, though it does appear to be secure in some other areas with suitable habitat remaining. Whether that grass or Torrey's Mountainmint persists or not in the future in areas where they are currently scarce appears to depend on the survival and maintenance of their habitats.

POTENTIAL THREATS

Globally, Torrey's Mountainmint has been judged to be Imperiled - it is a North American endemic with a limited overall range and the number of populations is rapidly declining (W-1; W-3). It appears to be unable to increase its range, and it may or may not recover.

Threats to the continued survival of Torrey's Mountainmint include 1] habitat destruction from urbanization and development, 2] timber harvest, 3] woody succession and canopy closure, 4] human, vehicle, cattle and horse trampling, 5] unrestricted recreational use of its habitat, 6] exotic plant competition, and 7] herbicide spraying and industrial, agricultural and domestic

pollution (W-3; Shawnee National Forest 2005).

Habitat destruction from urbanization and development can completely eliminate entire populations of plants as well as the habitats on which they depend. This has become a serious problem not only in populations of Torrey's Mountainmint, but also for many other species, and it is a national problem (W-3). Since European settlement, much of the previously available habitat has been destroyed, converted to cultivated fields, orchards, or commercial forests, or it has succumbed to land development (W-3). Only a few extant populations are in national forests or otherwise protected areas. It cannot be determined precisely how many populations have been lost before field botanists began to recognize the decline of this mint and before searches were initiated. Land development continues to be a major factor in the decline of this plant (Vandam 2004).

Timber harvesting is a known threat to Torrey's Mountainmint (W-3). Exposed plants can wilt quickly and die because their root systems are normally quite shallow. Direct sun tends to remove more water from the plants then they can take up by their weak root system, resulting in eventual decline and death of individuals and populations if the forest cover is completely removed. Furthermore, timber harvest can change the hydrology and drainage patterns of the forest slopes (W-3). Increased runoff can heighten the frequency and intensity of flooding and subsequent scouring of the shallow soils in which *Pycnanthemum torreyi* often grows. Both siltation and erosion from the runoff can prevent seedling establishment. Complete clearing or cutting of a forest stand could not be done where a colony occurs nor within its watershed upslope without such adverse effects.

In apparent contradiction, excessive shading generally through woody plant succession within its habitat can also be detrimental to Torrey's Mountainmint (W-3; Shawnee National Forest 2005). This is not really a contradiction, because this mint prefers open sunny woodland habitats – not fully exposed, but with dappled sunlight in open barrens or savanna-like habitats. Its preferred habitats are subject to occasional fires that keep the understory quite open (see Habitat and Ecology above). The low light levels created by a dense growth of trees and shrubs and the closing of the forest canopy would prevent significant amounts of light from reaching the plants, resulting in a suppression or even cessation of flowering and fruiting. Some populations actually grow in grasslands or otherwise open environments, and in the absence of fires, mowing has been recommended in some cases (W-3).

Vehicle, human, cattle, and horse trampling is another potential threat to this herbaceous species. The unrestricted human recreational use of its habitat poses a similar threat. The development of user-created trails in the Shawnee National Forest is thought to pose a major threat to several rare plant populations because of the resulting trampling of the plants (Shawnee National Forest 2005). The compaction and / or the loss of the thin soils present can cause the destruction of a plant colony by human, animal, or vehicular traffic. Utility crews, tractors, and recreational vehicles in particular pose a serious hazard to this species (W-3; Shawnee National Forest 2005).

Exotic pest plants are a known and serious threat to this species and should be removed. Torrey's Mountainmint is not an aggressive or competitive herb and it is easily overwhelmed and shaded out by more aggressively growing species. Movement of exotic aggressive plant species into an

area is often by means of trail or road construction (W-3). Japanese honeysuckle (*Lonicera japonica*) has been named as a primary threat to this species (W-3). Other plants that may cause competition problems for *Pycnanthemum torreyi* in Illinois and elsewhere may include (but are not restricted to) kudzu (*Pueraria lobata*), teasel (*Dipsacus* spp.), Autumn olive (*Elaeagnus umbellata*), Sericea lespedeza (*Lespedeza cuneata*), species of privet (*Ligustrum* spp.), and Multiflora rose (*Rosa multiflora*). Native aggressive species have also been named as potential problems to this plant (W-3), especially redbud (*Cercis canadensis*) and the blackberries (*Rubus* spp.).

Various types of industrial, agricultural and domestic pollution may have caused the loss of several populations of Torrey's Mountainmint around the country. The influx of excrement from horses and other domestic animals as well as the dumping of household and industrial trash can increase the growth of agricultural weeds that would soon overtake and replace populations of this mint. Herbicides, such as those used at forest margins, powerline, railroad, and highway rights-of-way, will eliminate this plant from an area (W-3). Such commonly used herbicides as Roundup are known to be particularly effective against broadleaf herbs, and so herbicides should not be used in the vicinity of these plants (W-3). Fire or controlled prescribed mowing may be an effective means of control for some of the exotic species that may become a problem for this mint depending on local topography and local restrictions.

It is generally believed among biologists that habitat fragmentation can have profound effects on the success and persistence of local populations. Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett and Kohn 1991). When one is considering populations that are already isolated, as in the case of any Illinois populations that may exist, random genetic drift may have already occurred and may have caused negative effects to the species.

At the current time, it is not known if populations of *Pycnanthemum torreyi* still persist in the Shawnee National Forest (or in Illinois). If the species is re-located, it will likely persist if it is protected from habitat change and disturbance but it may always be quite vulnerable. Protective fencing may be necessary.

RESEARCH AND MONITORING

Pycnanthemum torreyi appears to flower and fruit throughout its range and it has no known reproductive problems. This herb grows in very widely scattered and often isolated open forest sites and there appears to be very little interaction (pollen dispersal or seed exchange) with other populations of the same species in those areas because of its rarity.

The first priority in the research and monitoring of this mint in Illinois is to locate an extant population, of course. One would start by visiting historic sites reported for this mint. The searches for additional populations are especially needed to re-evaluate the plant's status.

Of equal importance at this time is to be certain that the local plants that have been given this name in the past are truly *Pycnanthemum torreyi* (or are they a distinctly different species?).

This can only be solved by careful taxonomic, and possibly, molecular studies by experienced botanists in the herbarium and laboratory.

Almost nothing is known about the basic life history and population biology of *Pycnanthemum torreyi*. Pollinators, plant longevity, self-compatibility of the flowers, viability and longevity of seeds, seed dispersal, seedling establishment, habitat requirements (such as area and buffers needed) are simply not known. Basic research is greatly needed in all of these areas.

If a population is again found in Illinois, annual monitoring of it will be essential to the local survival of this species (W-3). In parts of its range, both in areas where it is declining and in areas where it is still common, periodic monitoring is needed not only to supply data on the life history of this herb, but also to evaluate the threats to its habitat caused by habitat degradation or destruction, and threats from exotic species. Population stability, reproduction, and vigor should all be monitored. While hydrology and humidity fluctuations are assumed to occur in its habitat, it is not known precisely how much fluctuation can occur without adversely affecting the plants. It is also not known how well this herb can be established in newly opened forest sites, though it is probable that it could be successfully introduced to such sites based upon current knowledge of its habitat preferences. It is not known exactly how much disturbance can occur before an individual population is adversely affected, nor is it known how large an open habitat is needed to support a viable population. In particular, research on the use of fire management, already shown to have promising results, would be useful towards the understanding and preservation of Torrey's Mountainmint.

Monitoring of the forests where it occurs elsewhere (or where it may have been introduced) may assist in determining what the local environmental parameters should be for optimal health for this herb. Where it still occurs, periodic surveys are needed to determine the basic health and productivity of the population by periodically counting the numbers of individuals (among other things). This is the only means to determine population trends accurately (W-3). Reproductive success can be estimated by counting the number of fruiting stems produced each season because seedlings and young plants cannot easily be identified in the field. As part of the basic research on current populations of this species, data such as counts of numbers of individuals present (or the area covered by the colony), the determination of the amount of yearly flowering and seed production that might occur, and an assessment of recruitment rates are needed in order to monitor population dynamics and to assess the viability of the individual populations found. Individual plants should be monitored over a growing season at each site for basic phenology data. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not precisely known.

If new populations are found, voucher specimens should be made according to techniques described in Hill (1995) or other similar references. Similar habitat should be explored for the plant at its flowering and fruiting seasons. There are rather large areas of additional suitable habitat in southern Illinois where the herb could also exist. A list of associates and indicator species has been compiled as a result of field studies in other states (see Habitat section above) and these should also occur with the species in Illinois. These indicator plants can be very useful in facilitating the discovery of additional populations of this herb. Particular attention should be made to search for and / or monitor this herb at its peak period for flowering in one's local area,

probably in late July through early September (see cover illustration). It is quite possible that populations of this species either have been overlooked because of difficulties in field identification or because of the predominance of sterile plants thought to be other more common mints.

Botanical surveys conducted by scientists from the Illinois Natural History Survey and elsewhere have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated, or else threatened or endangered, occasionally can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S.D.A. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. Much of the locating and monitoring of known populations of rare species in southern Illinois has been conducted by Forest Service biologists, consultants, and students in cooperation with Illinois Department of Natural Resources personnel. However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. It appears that a high priority should be given to the training and hiring of more qualified field botanists to achieve these goals.

RESTORATION

Restoration efforts are being conducted on *Pycnanthemum torreyi* primarily through the protection of as many known populations as possible (W-3). However, the restoration potential of this species is largely unknown. It can probably be grown dependably from seeds, and it may also be propagated by means of rooted rhizome cuttings, but there seems to be little or no information available on the propagation of this particular species. Restoration efforts of several habitats where it grows are taking place throughout its range, and this may also help the species if it occurs on one or more of those sites.

The generally recommended method to restore populations of this and other rare plants is to protect and manage their habitat. Protection of the generally thin soil layer of the sites may be crucial, along with the maintenance of an open habitat. Girdling trees may be effective, as may be selective mowing (trimming) at a prescribed height (perhaps 1 meter). Exotic and aggressive species must be completely eliminated from each site. This would entail physically pulling them out because it is very likely that herbicide application would eliminate this species at a site as well. The use of controlled burns, the thinning of the overstory, and the thinning of competing understory species may be very beneficial to this plant (W-3; Shawnee National Forest 2005).

Of particular importance is the addition of significant buffer zones to any protected occurrences of Torrey's Mountainmint (W-3). One of the reasons for this is the recommended use of fire management, and the effects of smoke drift toward neighboring areas. Another strong recommendation is that cutting methods replace all herbicide use in areas where maintenance is needed in the vicinity of these plants (W-3). Likewise, in areas where this mint occurs that are already grasslands, a continual mowing regime may be used instead of fire management to keep natural woody plant succession in check (W-3).

Success in the restoration or viability of this plant at a site can be ranked from A to D according to the Nature Conservancy (W-3). An A-ranked, Excellent Viability, occurrence of *Pycnanthemum torreyi* should have more than 500 plants in contiguous habitat and have adequate recruitment to sustain population numbers at those levels. The population should occur in large areas of undisturbed dry upland forests and meadows, dry-mesic barrens, rocky woods, and sandstone glades surrounded by a buffer area and free of threats (W-3). A B-ranked, Good Viability, occurrence of *Pycnanthemum torreyi* should have between 100-500 plants in contiguous dry upland forests and meadows, dry-mesic barrens, rocky woods, and sandstone glades surrounded by a buffer area and significant patches of unoccupied, suitable habitat present for future colonization. Habitats may have minor threats, none of which are directly impacting or significantly degrading the habitat (*i.e.*, the site may have trails or be bisected by a road, or be located adjacent to inactive quarries, agricultural or cleared land, or low-density development (W-3). A C-ranked, Fair Viability, population of *Pycnanthemum torreyi* should have between 50-100 plants occurring in small areas of dry upland forests and meadows, dry-mesic barrens, rocky woods, and sandstone glades OR any moderate to large-sized habitat that is significantly disturbed and fragmented with a buffer less than optimal but with some remaining suitable habitat for future expansion (W-3). A D-ranked, Poor Viability, population of *Pycnanthemum torreyi* should have fewer than 50 plants or have a population of any size exhibiting a continual decline over a period of several years. The population should occur in small areas of dry upland forests and meadows, dry-mesic barrens, rocky woods, and sandstone glades with no buffer area or additional suitable habitat for future expansion, or the habitat may be heavily or irreversibly disturbed or altered, or with significant ongoing artificial disturbance directly impacting the population (W-3).

The Nature Conservancy and its Heritage Program normally recommends habitat restoration and protection rather than artificial propagation to save plant species. In some cases, very few plants, or even no plants, may be present and so an actual plant restoration may be necessary. Restorations of native plant species are recommended using only propagated material grown from native, local populations to avoid mixing genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions, or the result could be the success of a plant or plants that cannot be considered truly native (considered by some to be a plant community *reconstruction* rather than a restoration). Local plants should be propagated for planting in such an effort. Mints are normally easily propagated by means of seeds or rhizome cuttings under controlled conditions. If this plant is not found again in Illinois, and its restoration is still desired, material from the closest known native population should probably be obtained to establish a new population.

This mint is not generally known in cultivation and it does not appear to be available as seeds or plants from commercial nurseries.

SUMMARY

Torrey's Mountainmint, *Pycnanthemum torreyi* Benth., is a fragrant perennial herb normally found in drier uplands, and it has rather conspicuous whitish to purplish flowers clustered in

dense heads on its sparse branches. There may be some taxonomic problems with this plant. There are only about 20 living populations extant, and the species is known only from the United States; it has a somewhat scattered distribution in the south-central and eastern states, and it is known historically from sixteen to twenty states plus the District of Columbia, depending on one's interpretation of the species, from New Hampshire west to Kansas, south to Tennessee and Georgia. It has greatly declined in recent decades. Globally, its ranking is G2 (Imperiled world-wide) and its National status in the United States is N2 (Imperiled nationally). While rare everywhere, it is, or was, probably most common in Virginia, Pennsylvania, North Carolina and New Jersey. Torrey's Mountainmint is listed as Endangered in six states, Connecticut, Maryland, New Hampshire, New Jersey, New York, and Pennsylvania and it has been listed as a plant of Special Concern in Tennessee. It may have become extirpated in at least the District of Columbia, Illinois, Kansas, Missouri, and New Hampshire. In Forest Service Region 9, Torrey's Mountainmint is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest (though it has not been seen since 1987) but not the Hoosier National Forest where it has not been found. It is at risk everywhere in its range.

Suggested research priorities for this rare herb include attempts to locate and protect any extant populations because it has not been seen in Illinois since 1987. Once found, there should be an initiation of basic studies on its life history and population biology, studies to learn more about its successful propagation and restoration in the wild, and studies on the techniques on how best to protect its habitat from disturbance. Many basic facts about the plant's life history remain unknown, such as seed dormancy and viability, and plant longevity as well as its genetic diversity.

The management of any extant colonies of *Pycnanthemum torreyi* should include the closing of all trails and redirection of all management activities and traffic that may cause damage to the colonies, the use of prescribed fire, mowing, or the selective thinning of the canopy in order to maintain suitable light levels for growth and flowering, and the elimination of woody plant encroachment in the understory, particularly that of exotic species. Habitats need strict protection from destructive recreational activities, land development, indiscriminate herbicide application, trampling by native and non-native mammals and vehicles, and from the establishment of exotic species to allow it to persist where it may occur. At this time, the establishment of additional populations will be only through active human efforts.

REFERENCES

Barrett, B. C. H. and J. R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. [pp. 3-30 *In* Genetics and conservation of rare plants, D.A. Falk and K.E. Holtzinger, eds. Oxford University Press, New York, NY.

Bartholomew, C .S. 2004. Bees associated with Louisiana Longleaf Pine Savannas. Thesis, Masters of Science, Department of Entomology, Louisiana State University. 112 pp.

Bouman, F. and A. D. J. Meeuse. 1992 Dispersal in Labiatae. Pp. 193-202 *in* R.M. Harley and T. Reynolds (eds.) 1992. Advances in Labiate Science. Royal Botanic Gardens, Kew.

Brown, M. L. and R. G. Brown. 1984. Herbaceous Plants of Maryland. Port City Press, Inc., Baltimore, Maryland. 1127 pp.

Chambers, H.L. 1961. Chromosome numbers and breeding systems in *Pycnanthemum* (Labiatae). Brittonia 13: 116-128.

Chambers, H. L. and K. L. Chambers. 1971. Artificial and natural hybrids in *Pycnanthemum* (Labiatae). Brittonia 23(1): 71-88.

Deam, C.C. 1940. Flora of Indiana. Indiana Department of Conservation - Division of Forestry, Indianapolis.1236 pp.

Fernald, M. L. 1899. *Pycnanthemum verticillatum*, a misinterpreted mint. Botanical Gazette 28 (2) 130-133.

Fernald, M. L. 1950. Gray's Manual of Botany. Eighth Edition. Dioscorides Press, Portland, OR.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd edition. The New York Botanical Garden, Bronx.

Grant, E. and C. Epling. 1943. A study of *Pycnanthemum* (Labiatae). Univ. California Publ. Bot. 20: 195-240.

Greuter, W. *et al.* (eds.) 2000. International Code of Botanical Nomenclature. Koeltz Scientific Books, Königstein, Germany. 474 pp.

Herkert, J. R. and J. E. Ebinger (eds.) 2002. Endangered and Threatened Species of Illinois: Status and Distribution, Volume 1 - Plants. Illinois Endangered Species Protection Board, Springfield, Illinois. 161 pp.

Hill, S. R. 1995. How to Make a Plant Collection. Herbarium Supply Company, Menlo Park, CA. 8 pp.

Hill, S. R. 2002. Some recent changes in the Illinois flora. Illinois Natural History Survey Reports. Summer 2002. No. 3722.

Hill, S. R. 2003. Conservation Assessment for Ofer Hollow Reedgrass (*Calamagrostis porteri* A.Gray ssp. *insperata* (Swallen) C.W. Greene). Produced for the USDA Forest Service, Eastern Region, by the Center of Biodiversity, Illinois Natural History Survey, Champaign, 28 April 2003. 30 pp.

Illinois Endangered Species Protection Board [IESPB]. 2005. Checklist of Endangered and Threatened Animals and plants of Illinois. Illinois Endangered Species Protection Board. Springfield, Illinois. 16 pp.

Jones, R. L. and P. S. White. 1981. The Vascular Flora of Shiloh National Military Park, Hardin County, Tennessee. National Park Service Res. / Resources Management Report No. 50. Atlanta.

Kartesz, J. T. (data) and C. A. Meacham (software). 1999. Synthesis of the North American Flora. Version 1.0. CD-ROM. Biota of North America Program, North Carolina Botanical Garden, Chapel Hill.

Lamont, E. E. and S. M. Young. 2004. Noteworthy plants reported from the Torrey Range – 2002 and 2003. Torrey Bot. Soc. 131: 394-402.

Mabberley, D. J. 1987. The plant-book, a portable dictionary of the vascular plants. 2nd Ed. p. 564, Cambridge: Cambridge University Press.

Magee, D. W. and H. E. Ahles. 1999. Flora of the Northeast. University of Massachusetts Press: Amherst.

McGregor, R. L., R. E. Brooks, and L. A. Hauser. 1976. Checklist of Kansas vascular plants. Techn. Publ. State Biol. Surv. Kansas 2: 1-168.

McNeill, J. *et al.* (eds.) 2006. International Code of Botanical Nomenclature (Vienna Code). Regnum Vegetabile 146. A.R.G. Gantner Verlag KG. ISBN 0080-0694. 568 pp.

Meagher, T. R. 1978. The Evolutionary Consequences of Dioecy in *Chamaelirium luteum*, a Perennial Plant Species. Ph.D. dissertation, Duke University, Durham, NC.

Meagher, T. R. and J. Antonovics. 1982. The population biology of *Chamaelirium luteum*, a dioecious member of the lily family: life history studies. Ecology 63: 1690-1700.

Meagher, T. R. and E. Thompson. 1987. Analysis of parentage for naturally established seedlings of *Chamaelirium luteum* (Liliaceae). Ecology 68: 803-812.

Miller, S. G., S. P. Bratton, and J. Hadadian. 1992. Impacts of white-tailed deer on endangered and threatened vascular plants. Natural Areas Journal 12: 67-74.

Mohlenbrock, R. H. 2002. Vascular Flora of Illinois. Southern Illinois University Press. Carbondale. 491 pp.

Mohlenbrock, R.H. and D.M. Ladd. 1978. Distribution of Illinois vascular plants. Southern Illinois University Press. Carbondale. 282 pp.

Radford, A. E., H. A. Ahles, and C. R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press: Chapel Hill.

Reed, P. B., Jr. 1988. National list of plant species that occur in wetlands: national summary.

U.S. Fish Wildlife Service Biol. Rep. 88(24).

Rhoads, A. F. and T. A. Block. 2000. The plants of Pennsylvania: an illustrated manual. University of Pennsylvania press, Philadelphia. 1061 pp.

Schwegman, J. E., G. B. Fell, M. D. Hutchinson, G. Paulson, W. M. Shephard, and J. White. 1973. Comprehensive plan for the Illinois Nature Preserve system. Part 2. The natural divisions of Illinois. Illinois Nature Preserves Commission, Rockford. 32 pp.

Shawnee National Forest. 2005. Shawnee National Forest biological evaluation of Regional Forester's Sensitive plant species. Forest Plan Revisions. Shawnee National Forest. Harrisburg, Illinois. Available at: http://www.fs.fed.us/r9/forests/shawnee/projects/forest_plan_revision/documents/plant-be.pdf

Smith, E. B. 1978. An Atlas and Annotated List of the Vascular Plants of Arkansas, 2nd printing 1979. University of Arkansas Bookstore, Fayetteville. 592 pp. + addenda.

Steyermark, J. A. 1963. Flora of Missouri. The Iowa State University Press: Ames. 1728 pp.

Vandam, J. 2004. Neighborhood Report: Charleston; for proposed development, a tiny but formidable foe. The New York Times, newspaper article, August 1, 2004.

Van der Pijl, L. 1969. Principals of Dispersal in Higher Plants. Springer-Verlag.

Wherry, E.T., J.M. Fogg and H.A. Wahl. 1979. Atlas of the Flora of Pennsylvania. Morris Arboretum of the University of Pennsylvania, Philadelphia, PA.

White, J. and M. H. Madany. 1978. Classification of natural communities in Illinois. pp. 310-405 (Appendix 30) *In*: White, J., 1978. Illinois Natural Areas Technical Report, Volume 1. Survey Methods and Results. Illinois Natural Areas Inventory, Urbana.

Yatskievych, G. 1999. Steyermark's Flora of Missouri. Vol. 1. The Missouri Botanical Garden Press: St. Louis. 991 pp.

WEBSITES CONSULTED

W-1. U.S.D.A., NRCS. 2007. The PLANTS Database, Version 3.5. National Plant Data Center, Baton Rouge, LA 70874-4490, USA. http://plants.usda.gov/cgi_bin/topics.cgi

W-2. National Wetlands Inventory. U.S. Fish and Wildlife Service, Washington, DC. http://www.fws.gov/nwi/

W-3. NatureServe Explorer (The Nature Conservancy): An online encyclopedia of life. 2007. Version 1.6. Arlington, Virginia, USA. http://www.natureserve.org/

W-4. Significant Habitats and habitat complexes of the New York Bight Watershed. http://training.fws.gov/library/pubs5/web_link/text/pmt_form.htm

W-5. Dismal Creek Watershed, Forests of the Central Appalachians. http://asecular.com/forests/dismalcreekdoo.htm

W-6. U.S.D.A. Forest Service, Region 9, Regional Forester Sensitive Plants, Signed by Regional Forester 29 February 2000. List maintenance on 20 October 2003. http://www.fs.fed.us/r9/wildlife/tes/docs/rfss_plants.pdf

W-7. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. http://www.natureserve.org/explorer/ranking.htm

W-8. Botany On-line - Reproductive Isolation. University of Hamburg, Germany. http://www.biologie.uni-hamburg.de/b-online/e38/38d.htm

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APPENDIX 1

Representative specimens of *Pycnanthemum torreyi* examined or cited in the literature

Herbaria:

MO = Missouri Botanical Garden, St. Louis. MU = Miami University, Oxford, OH. SIM = Staten Island Institute of Arts and Science, NY. YU = Yale University, New Haven, CT.

CONNECTICUT: NEW HAVEN CO., West Rock State Park, New Haven, 15 Aug 1986, *Yetter P167A* (MU).

DELAWARE: KENT CO., Felton, Aug 1878, *Canby s.n.* (MO); NEW CASTLE CO., Centreville, 3 Aug 1878, *Commons s.n.* (MO).

DISTRICT OF COLUMBIA: "flora of Washington, D.C. and vicinity...Woody hill", 18 Jul 1896, *Steele 80* (MO); in viciniis Washington, D.C., Sep 1878, *Chickering, Jr. s.n.* (MO).

GEORGIA: RABUN CO., about Estatoah Falls on Mud Creek, 12 Aug 1893, *Small s.n.* (MO).

MISSOURI: DUNKLIN CO., 21 Oct 1892, *Bush s.n.* (MO).

NEW JERSEY: HUNTERDON CO., 1 mi N of Byram, bank of Delaware River, 11 Jul 1931, *Loughridge s.n.* (MU); without locality or date, *Durand s.n.* (MO).

NEW YORK: RICHMOND CO., Richmond Valley, Staten Island, 22 Jul 1864, *Leggett s.n.* (SIM).

OHIO: ADAMS CO., Edge of Appalachia Preserve, Teakettle East, Burn unit, 8 Aug 1989, *Smith s.n.* (MU); BUTLER CO., Oxford, **cultivated** in herb garden, 20 Jul 1995, *Vincent 7147* (MU); JACKSON CO., Bethel Ridge Road 69, Liberty Township, 16 Jul 1978, *Bryant 850* (MU). [These may be *P. verticillatum* – need verification]

PENNSYLVANIA: LANCASTER CO., at Conewago, 27 Sep 1901, *Heller s.n.* (MO); in Trap at Conewago, 29 Sep 1892, *Heller 652* (MO); vicinity of Conewago, 30 Aug 1890, *Small s.n.* (MO); Rawlinsville, 1884, *Galen s.n.* (MO – label said Tennessee); without location, 1832, *Moser s.n.* (MO).

SOUTH CAROLINA: GREENVILLE CO., Caesar's Head, Blue Ridge, 3 Sep 1876, *Redfield 6490* (MO).

TENNESSEE: SUMNER CO., Old Gallatin Road by railroad, 29 Jul 1975, *Kral 56077* (MO).

VIRGINIA: ROCKBRIDGE CO., just east of Buena Vista, *Chambers 1631* (YU); SOUTHAMPTON CO., near Raccoon Creek, north of Mill Neck Church, 9 Jul 1940, *Fernald & Long 12462* (MO).

APPENDIX 2.

The Historic Distribution of *Pycnanthemum torreyi* in the United States. Information from herbarium specimens and the literature.

STATE	COUNTIES	NOTES
Arkansas	Reported in Stone County (?)	Smith (1978) – included as synonym of *P. verticillatum*]
Connecticut	Hartford, New Haven	W-1; W-3; Magee and Ahles (1999)
Delaware	Kent, New Castle, Sussex	W-1; W-3
District of Columbia	Historic only	W-1; W-3
Georgia	Rabun	W-1; herbarium specimen
Illinois	Alexander, Jackson, Pope	W-1; W-3;Mohlenbrock & Ladd (1978); Mohlenbrock (2002); includes Shawnee N.F.
Indiana	Brown	W-1; W-3
Kansas	Wyandotte	W-1; W-3; Grant and Epling (1943)
Kentucky	Calloway, Fulton, Livingston, Lyon, Marshall, Ohio, Todd	W-1; W-3
Maryland	Baltimore, Caroline, Cecil, Dorchester, Frederick, Howard, Prince Georges	W-1; W-3
Missouri	Dunklin [historic]	see W-2; Steyermark (1963); Yatskievych (1999)
New Hampshire	Hillsborough	W-1; W-3; Magee and Ahles (1999)
New Jersey	Bergen, Essex, Gloucester, Hunterdon, Middlesex, Monmouth, Morris, Passaic	W-1; W-3
New York	Dutchess, Genesee, Richmond, Rockland, Suffolk, Westchester	W-1; W-3
North Carolina	Alexander, Ashe, Cleveland, Granville, Haywood, Jackson, Macon, Orange, Wilkes, possibly more; Radford *et al*. (1968) lists 16 counties for *P. verticillatum*, primarily mountains	W-1; W-3; Radford *et al.* (1968) [but included in *Pycnanthemum verticillatum* – in error?]
Ohio	Adams, Jackson	Herbarium specimens (MU); not yet confirmed. Michael Vincent (pers. comm.).

Pennsylvania	Bedford, Berks, Bucks, Dauphin, Delaware, Franklin, Huntingdon, Indiana, Lancaster, Northampton, York	W-1; W-3; Wherry *et al.* (1979); Rhoads and Block (2000) [all as *P. torreyi*]
South Carolina	Greenville, Pickens	W-1; W-3; Radford *et al.* (1968) [but included in *Pycnanthemum verticillatum* – in error?]
Tennessee	Dickson, Hardin, Sumner [?]	W-1; W-3; Jones and White (1981); herbarium specimen
Virginia	Bland, Campbell, Dinwiddie, Fairfax, Fauquier, Franklin, Giles, Greensville, Lunenburg, Nelson, Rockbridge, Southampton, Sussex	W-1; W-3; herbarium specimens
West Virginia	Fayette, Jefferson	W-1; W-3

APPENDIX 3.

Natural Diversity Database Element Ranking System

Modified from: http://www.cnpsci.org/html/PlantInfo/Definitions2.htm [W-7]

Global Ranking (G)

G1
Critically imperiled world-wide. Less than 6 viable elements occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

G2
Imperiled world-wide. 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

G3
Vulnerable world-wide. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

G4
Apparently secure world-wide. This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

G5
Secure globally. Numerous populations exist and there is no danger overall to the security of the element.

GH
All sites are historic. The element has not been seen for at least 20 years, but suitable habitat still exists.

GX
All sites are extirpated. This element is extinct in the wild.

GXC
Extinct in the wild. Exists only in cultivation.

G1Q
Classification uncertain. The element is very rare, but there is a taxonomic question associated with it.

National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the same suffixes (clarifiers) as the global ranking system above.

Subspecies Level Ranking (T)

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (*i.e*., *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

State Ranking (S)

S1
Critically imperiled. Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

S2
Imperiled. 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

S3
Vulnerable. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

S4
Apparently Secure. This rank is clearly lower than S3 but factors exist to cause some concern (*i.e.*, there is some threat, or somewhat narrow habitat).

S5
Secure. Demonstrably secure to ineradicable in the state.

SH
All state sites are historic; the element has not been seen for at least 20 years, but suitable habitat still exists. Possibly extirpated.

SNR, SU
Reported to occur in the state. Otherwise not ranked.

SX
All state sites are extirpated; this element is extinct in the wild. Presumed extirpated.

Notes:

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.

2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (*e.g.*, **S2S3** means the rank is somewhere between S2 and S3), and by adding a '?' to the rank (*e.g.* S2?). This represents more certainty than S2S3, but less than S2.